

# Measuring Critical Care Providers' Attitudes About Controlled Donation After Circulatory Death

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## Abstract

**Introduction:** Unfavorable attitudes and insufficient knowledge about donation after cardiac death among critical care providers can have important consequences for the appropriate identification of potential donors, consistent implementation of donation after cardiac death policies, and relative strength of support for this type of donation. The lack of reliable and valid assessment measures has hampered research to capture providers' attitudes. **Design and Research Aims:** Using stakeholder engagement and an iterative process, we developed a questionnaire to measure attitudes of donation after cardiac death in critical care providers ( $n = 112$ ) and examined its psychometric properties. Exploratory factor analysis, internal consistency, and validity analyses were conducted to examine the measure. **Results:** A 34-item questionnaire consisting of 4 factors (Personal Comfort, Process Satisfaction, Family Comfort, and System Trust) provided the most parsimonious fit. Internal consistency was acceptable for each of the subscales and the total questionnaire (Cronbach  $\alpha > .70$ ). A strong association between more favorable attitudes overall and knowledge ( $r = .43$ ,  $P < .001$ ) provides evidence of convergent validity. Multivariable regression analyses showed that white race ( $P = .002$ ) and more experience with donation after cardiac death ( $P < .001$ ) were significant predictors of more favorable attitudes. **Conclusion:** Study findings support the utility, reliability, and validity of a questionnaire for measuring attitudes in critical care providers and for isolating targets for additional education on donation after cardiac death.

## Keywords

organ donation, deceased donation, attitudes

## Introduction

The Uniform Anatomical Gift Act provides for the donation of organs following the declaration of death.<sup>1</sup> The Uniform Determination of Death Act provides that death may be declared based on the cessation of neurological or circulatory function. The neurological determination of death is based on irreversible loss of function of the whole brain, including the brain stem. The circulatory determination of death is based on the irreversible cessation of circulatory function. Both criteria are legally recognized as the valid basis for declaration of death in the United States.<sup>2</sup> Controlled donation after circulatory determination of death (DCD) involves a coordinated sequence of steps with in-hospital patients who have severe musculoskeletal disease, spinal cord injury, or irreversible brain injury and who do not meet criteria for brain death. Often DCD policies and protocols vary across medical centers, but the principle steps and their sequence are generally the same: (1) family decision to withdraw ventilator or mechanical support, (2) assessment for DCD eligibility, (3) organ procurement

organization (OPO) confirmation of registered donor status or donation request and family authorization for donation, (4) withdrawal of ventilator or mechanical support, (5) pre-mortem interventions (eg, catheterization, vasodilators, anticoagulants), (6) declaration of death by circulatory determination, and (7) organ removal.<sup>3-5</sup>

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While there has been some growth in organ donation after brain death during the past decade, the increase in donation after circulatory determination of death has been much more dramatic. In the past 15 years, there has been a more than 10-fold increase in the number of DCD donors and a 5-fold increase in the number of DCD organs procured and transplanted in the United States.<sup>6,7</sup> Kidneys and livers from DCD donors are most often transplanted, although there is growing experience with transplanting DCD lungs, hearts, and pancreata.<sup>7-10</sup> Maximizing DCD is important, since it provides more transplantable organs at a time when the demand (number of patients waiting for transplantation) and supply (number of transplantable organs) gap continues to widen.

Research has shown that the organ donation attitudes of health-care providers are critical to family authorization rates when the deceased's donation intentions are unknown. Families are significantly more likely to authorize donation following brain death when they perceived that health-care providers were supportive of donation and receptive to discussing donation.<sup>11-13</sup> Interestingly, however, health-care providers seem to have less favorable attitudes toward DCD, compared to donation after brain death.<sup>14-19</sup> Unfavorable DCD attitudes and insufficient knowledge about DCD policies among critical care providers can have important consequences for the appropriate identification of potential donors, timely referral to the local OPO, willingness to discuss organ donation with family members, consistent implementation of DCD policies, and relative strength of support for the DCD process.

To date, attitudes toward DCD have been measured using focus groups, open-ended questions, a few specific questions about level of support for DCD, and questions linked to specific case scenarios. An objective measure designed to measure DCD attitudes in health-care providers would facilitate research or evaluation of educational programs pertaining to this topic. D'Alessandro et al,<sup>19</sup> developed a questionnaire to assess general perceptions about the organ donation process, comparisons of DCD versus brain death, and potential barriers to DCD among certified donation requestors. Although a factor analysis was performed to support their conceptual model regarding DCD support, details of that analysis and psychometric assessment were not provided. Also, nurses comprised the majority (81%) of the sample, with physicians being under-represented (<1%). The aim of this study, therefore, was to develop a questionnaire to measure health-care providers' DCD attitudes that can be quantified and standardized for use in research, quality improvement, and educational contexts. We examined the initial psychometric properties of the DCD Attitudes Scale in a sample of critical care providers. Additionally, we sought to characterize common DCD attitudes and DCD knowledge gaps.

## Methods

Study procedures were reviewed by the Committee on Clinical Investigations at Beth Israel Deaconess Medical Center,

which certified the exempt status of the protocol, under exemption number 2.

### *Instrument Development: DCD Attitudes Scale*

To generate items for the DCD Attitudes Scale, we reviewed previous publications assessing DCD attitudes and solicited input from 2 psychologists with organ donation research experience, 3 OPO deceased donation coordinators, 2 critical care physicians, 2 critical care nurses, and 2 adults who were previously approached about possible DCD for a family member (1 authorized, 1 refused). Initially, 43 items were generated or gathered from other questionnaires,<sup>19</sup> although subsequent review and discussion by the expert panel resulted in the rewording of some items to improve clarity, combining of some items with nearly identical themes, generation of new items, and elimination of other items. This resulted in a total of 37 items, each with 5 response options (1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree). The questionnaire was anchored so higher scores would reflect more favorable DCD attitudes, which necessitated that several items be reverse scored.

### *Donation After Circulatory Death Knowledge*

Due to considerable variability in DCD practices and policies,<sup>20,21</sup> the measurement of DCD knowledge must capture institution-specific practices and policies. To that end, we reviewed the written DCD policy at the study medical center and generated 16 true-false items reflecting specific policy elements. After expert panel review of these items for wording, clarity, accuracy, and redundancy, we were left with 14 items, with a possible total score ranging from 0 to 14 (higher scores = more knowledge of DCD policy).

### *Recruitment*

We sent an e-mail to critical care staff at 1 academic medical center, describing the study purpose and providing a secure hyperlink to complete the survey online. Survey responses were anonymous and downloaded directly into Research Electronic Data Capture (Vanderbilt University, Nashville, Tennessee), a secure web application for managing online surveys and databases. A reminder e-mail with the survey hyperlink was sent 3 and 8 weeks later.

### *Data Analysis*

Data were analyzed using SPSS software (IBM Statistics, Armonk, New York). First, we calculated descriptive statistics on demographic characteristics of the survey respondents. Second, we examined the internal consistency of DCD knowledge questionnaire using the Kuder-Richardson formula (KR-20). Third, a series of analyses were conducted to assess the DCD Attitudes Scale. We calculated the mean and standard deviation (SD) of each item and examined item-total correlations. Exploratory factor analysis using principal axis procedures and

promax rotation was used to examine factor structure. The minimal average partial strategy was used to determine the number of factors.<sup>22</sup> Items with low factor loadings (<0.40) in the initial factor analysis were removed and a second exploratory factor analysis was performed. Internal consistency of each subscale and the total measure was calculated using Cronbach  $\alpha$ . Convergent validity was examined through association with DCD knowledge. We hypothesized that more favorable DCD attitudes would be associated with higher DCD knowledge. To examine construct validity, we examined whether DCD attitudes differed based on certain sociodemographic characteristics. Specifically, we hypothesized that those respondents who were registered organ donors, white, and had more DCD experience would have more favorable DCD attitudes compared to those who were not registered as donors, minority race, and had less DCD experience. Third, univariate analyses were conducted to examine whether DCD attitudes were associated with demographic characteristics. Fourth, linear regression was used to examine multivariable predictors of total DCD attitudes. We used standard diagnostic procedures to validate assumptions of linearity (scatterplot), absence of outliers (scatterplot, casewise analysis), normal distribution of residuals (normal P-P plot), independence (Durbin-Watson test), and homoscedasticity (boxplot and Levene test). Lastly, we describe the most common DCD attitudes, as well as the most common gaps in DCD knowledge, using means, frequencies, and percentages.

## Results

### Respondents

One hundred twelve (N = 112) critical care providers returned usable surveys, representing a 72% response rate. Table 1 presents the sociodemographic characteristics of the respondents. Physicians (49%) and nurses (42%) were equally represented, and most were women (72%), white (80%), and registered organ donors (68%). Two-thirds (65%) reported 5 or fewer years of intensive care unit (ICU) experience, and more than half had no (29%) or minimal (1-3 cases, 38%) direct experience with DCD.

### Donation After Circulatory Death Knowledge

A total DCD knowledge score was calculated by summing all correct responses. Knowledge scores ranged from 7 to 14 (mean = 10.4, SD = 1.6), and the questionnaire demonstrated acceptable internal consistency reliability (0.79).

### Donation After Circulatory Death Attitudes Scale

**Exploratory factor analysis.** Three items showed low factor loadings (<0.40) in the initial factor analysis and, therefore, were removed (“I feel that a DCD donor is heroic,” “I feel that the organ procurement organization should give critical care staff detailed feedback about whether DCD organs were transplanted,” and “I feel that I have a good understanding of my

**Table 1.** Respondent Characteristics.<sup>a</sup>

Characteristic	Mean (SD) or n (%)
Profession	
Physician <sup>b</sup>	55 (49)
Nurse	47 (42)
Allied health <sup>c</sup>	10 (9)
Age	39.7 (11.7)
Sex, female	81 (72)
Race, white	90 (80)
ICU experience	
<1 year	36 (32)
1 to 5 years	37 (33)
>5 years	39 (35)
DCD experience	
None	32 (29)
Minimal (1-3 cases)	42 (38)
Moderate (4-9 cases)	23 (21)
Extensive ( $\geq 10$ cases)	15 (13)
Organ donation status	
Registered	76 (68)
Not registered	36 (32)

Abbreviations: DCD, donation after circulatory death; ICU, intensive care unit; SD, standard deviation.

<sup>a</sup>N = 112.

<sup>b</sup>Includes 28 faculty, 23 residents, and 4 clinical fellows.

<sup>c</sup>Includes 5 social workers, 2 psychiatrists, 2 medical ethicists, and 1 clergy.

medical center’s DCD policy”). Data for the remaining 34 items were found to be suitable for structure detection using factor analysis: Kaiser-Meyer-Olkin measure of sampling adequacy = 0.71 and Bartlett test of sphericity = 2077.64,  $P < .0001$ . Subsequent exploratory factor analysis showed that a 4-factor solution was the best fitting model: factor 1 (Personal Comfort, 10 items, score range = 10-50, 29.2% of variance), factor 2 (Process Satisfaction, 10 items, score range = 10-50, 12.7% of variance), factor 3 (Family Comfort, 7 items, score range = 7-35, 6.5% of variance), and factor 4 (System Trust, 7 items, score range = 7-35, 5.1% of variance). The full model accounted for 53.73% of variance (Table 2).

**Reliability.** High internal consistency reliability was found for the total scale (Cronbach  $\alpha = .91$ ). Internal consistency estimates for the 4 subscales are reported in Table 2. Although not as high as for the full scale, all coefficients are considered acceptable ( $>.70$ ).

**Validity.** Good convergent validity was demonstrated as higher knowledge of the institution’s DCD policy was associated with more favorable DCD attitudes overall ( $r = .43$ ,  $P < .001$ ). Of the 4 factors, 3 showed strong correlations with DCD knowledge (Personal Comfort:  $r = .46$ ,  $P < .001$ ; Process Satisfaction:  $r = .32$ ,  $P < .001$ ; Family Comfort:  $r = .41$ ,  $P < .001$ ). System Trust was not significantly associated with knowledge ( $r = .19$ ,  $P = .07$ ). Regarding construct validity, registered organ donors had significantly more favorable DCD attitudes overall than those who were not registered donors (mean [SD], 123.8 [17.6] vs 111.2 [11.1],  $t = 3.9$ ,  $P < .01$ ). Registered organ

**Table 2.** Pattern Matrix Result of Exploratory Factor Analysis for DCD Attitudes Scale.<sup>a</sup>

Item	F1	F2	F3	F4	M	SD	h <sup>2,b</sup>	ITC	Strongly Agree or Agree (%)	Strongly Disagree or Disagree (%)
I feel that the DCD donation process is “eerier” than the brain death donation process. <sup>c</sup>	<b>0.755</b>	0.138	−0.033	0.043	3.42	1.1	0.75	0.735	19	51
I feel that it is easier for me to “let go” of a brain-dead patient than a DCD patient. <sup>c</sup>	<b>0.683</b>	−0.190	0.296	0.064	3.22	1.2	0.72	0.624	27	50
I feel less comfortable with the death criteria for DCD than for brain death. <sup>c</sup>	<b>0.659</b>	0.368	−0.257	0.073	3.12	1.2	0.75	0.662	38	38
I feel comfortable talking with family members about withdrawal of life support. <sup>d</sup>	<b>0.527</b>	−0.153	0.138	0.251	3.99	1.0	0.81	0.457	81	13
I feel comfortable with the DCD process. <sup>d</sup>	<b>0.507</b>	−0.029	0.377	−0.017	3.52	1.0	0.77	0.726	53	15
I feel perfectly comfortable talking with family members about DCD. <sup>d</sup>	<b>0.455</b>	0.140	0.019	−0.309	2.81	1.2	0.84	0.592	26	48
I feel that donation after brain death is not consistent with my religious or spiritual beliefs.	<b>0.444</b>	0.021	0.253	−0.163	4.41	0.8	0.84	0.573	3	86
I feel that DCD is not consistent with my religious or spiritual beliefs.	<b>0.435</b>	0.209	−0.069	−0.118	4.37	0.8	0.79	0.628	2	88
In DCD cases, I feel perfectly comfortable giving full comfort measures to the patient. <sup>d</sup>	<b>0.429</b>	0.101	−0.186	−0.126	4.03	1.0	0.79	0.427	79	7
I feel less comfortable with the process of DCD than with donation after brain death.	<b>0.378</b>	0.016	0.202	0.053	3.05	1.1	0.66	0.528	31	35
I feel that staffing demands for DCD cases are too high and burdensome for the intensive care unit.	0.062	<b>0.877</b>	−0.164	0.37	3.33	1.0	0.80	0.724	25	47
I feel that OPO requestors should speak to families about the DCD option when the family is considering life support withdrawal. <sup>d</sup>	−0.104	<b>0.846</b>	−0.123	0.318	3.73	1.0	0.73	0.385	77	15
I feel that the time of continuous pulselessness or asystole before declaring death is too short.	−0.072	<b>0.781</b>	0.109	−0.159	3.67	1.0	0.82	0.720	16	60
I feel that DCD cases are more difficult and less predictable than donation after brain death cases.	−0.184	<b>0.771</b>	−0.049	0.345	2.22	1.1	0.78	0.505	69	12
I feel that DCD cases are more stressful for critical care staff than donation after brain death cases.	−0.002	<b>0.728</b>	−0.142	0.348	2.64	1.0	0.78	0.552	62	19
I feel that death is declared too soon in DCD cases.	0.061	<b>0.614</b>	0.165	−0.245	3.82	0.9	0.86	0.759	11	66
I feel that our hospital should not allow DCD.	−0.040	<b>0.536</b>	0.233	−0.112	4.35	0.7	0.74	0.529	1	87
I feel that a family’s decision about DCD should be part of end-of-life care, just like withdrawal of mechanical ventilation. <sup>d</sup>	−0.076	<b>0.490</b>	0.063	0.127	3.90	1.0	0.68	0.405	79	11
I feel that a problem with DCD is that the health-care team has to “watch” patients take their last breath. <sup>c</sup>	0.049	<b>0.479</b>	0.202	−0.217	3.76	0.9	0.79	0.582	10	64
I feel that transplant outcomes using DCD organs are just as good as those for organs recovered after brain death. <sup>d</sup>	0.050	<b>0.463</b>	−0.453	0.102	2.78	0.9	0.81	0.331	17	34
I feel that DCD “trivializes” the patient’s death and gives the death less meaning. <sup>c</sup>	−0.308	0.105	<b>0.926</b>	0.113	4.41	0.8	0.77	0.493	2	86
I feel that DCD is less stressful for families than donation after brain death. <sup>d</sup>	0.041	0.235	<b>0.819</b>	0.108	2.73	0.8	0.77	0.451	14	32
I feel that DCD is psychologically less difficult than donation after brain death. <sup>d</sup>	0.327	0.137	<b>0.683</b>	−0.077	2.80	1.0	0.82	0.501	24	38
I feel that most families find comfort in DCD. <sup>d</sup>	−0.014	−0.023	<b>0.657</b>	0.408	3.33	0.8	0.82	0.579	42	12

(continued)

Table 2. (continued)

Item	F1	F2	F3	F4	M	SD	h <sup>2,b</sup>	ITC	Strongly Agree or Agree (%)	Strongly Disagree or Disagree (%)
I feel that DCD allows something positive to come out of the patient's death. <sup>d</sup>	0.122	0.172	<b>0.620</b>	0.113	4.28	0.8	0.70	0.620	89	6
I feel that a family should be able to refuse DCD, even if the deceased was a registered organ donor.	0.147	0.184	<b>0.482</b>	0.213	3.61	1.2	0.74	0.585	25	65
I feel that cultural issues are not adequately considered in DCD cases.	0.243	0.034	<b>0.401</b>	0.116	3.39	0.9	0.75	0.567	16	47
I feel that the OPO cares only about the number of organs recovered. <sup>c</sup>	0.016	-0.064	0.046	<b>0.839</b>	4.14	0.8	0.78	0.758	6	84
I feel that the OPO is trustworthy. <sup>c,d</sup>	0.170	-0.122	0.239	<b>0.738</b>	4.34	0.7	0.80	0.680	93	4
I feel that "circulatory death" was developed solely for the purpose of increasing organ donation.	0.127	0.043	0.106	<b>0.622</b>	3.67	1.0	0.75	0.607	13	62
I feel that the DCD policy at my medical center is implemented consistently. <sup>d</sup>	-0.106	0.170	0.120	<b>0.621</b>	3.18	1.0	0.72	0.611	38	19
I feel that the health-care team is playing an active role in killing the patient in DCD cases. <sup>c</sup>	-0.038	0.338	0.042	<b>0.573</b>	4.44	0.7	0.71	0.685	2	89
I feel that at the time of organ recovery in DCD cases, I am not sure that the patient is truly dead.	0.374	-0.056	-0.237	<b>0.530</b>	3.86	1.1	0.79	0.788	15	70
I feel that with DCD we are hastening the patient's death. <sup>c</sup>	0.040	0.248	-0.143	<b>0.424</b>	4.16	0.9	0.72	0.633	4	83
Cronbach $\alpha$	0.794	0.738	0.789	0.800						
Eigenvalue	9.934	4.100	3.163	2.870						
Percentage of variance	29.218	12.733	6.587	5.191						
Mean (SD)	35.9 (6.0)	34.2 (5.2)	24.5 (3.4)	27.8 (4.2)						

Abbreviations: DCD, donation after circulatory death; ITC, item-subtotal correlations; OPO, organ procurement organization; SD, standard deviation.

<sup>a</sup>Unique factor loadings > 0.40 are indicated in bold; F1 = Personal Comfort; F2 = Process Satisfaction; F3 = Family Comfort; F4 = System Trust; h<sup>2</sup> = communalities; item responses: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, 5 = strongly disagree; total percentage of variance = 53.73.

<sup>b</sup>All items,  $P < .01$ .

<sup>c</sup>Similar to original items from the study by D'Alessandro et al.<sup>19</sup>

<sup>d</sup>Reverse scored.

donors also had significantly higher scores on the Personal Comfort and Family Comfort subscales ( $P = .02$  and  $P = .03$ , respectively). Additionally, more favorable DCD attitudes overall were associated with white race (mean [SD], 124.5 [15.0] vs 114.7 [19.3],  $t = 2.6$ ,  $P = .01$ ) and more DCD experience ( $F = 4.0$ ,  $P = .01$ ). Whites had higher Personal Comfort ( $P = .04$ ), Process Satisfaction ( $P < .01$ ), and System Trust ( $P = .02$ ) subscale scores than minorities. Those with more DCD experience had higher Personal Comfort ( $P = .003$ ) and System Trust ( $P < .001$ ) scores relative to those with less DCD experience. Donation after circulatory death attitudes did not differ significantly by age, gender, profession type, ICU experience, or total years of health-care experience ( $P$  values > .05).

### Multivariable Predictors of Overall DCD Attitudes

Results of the multivariable regression model showed that white race (unstandardized  $B = -11.81$ ,  $t = 3.1$ ,  $P = .002$ ) and more DCD experience (unstandardized  $B = 5.73$ ,

$t = 3.8$ ,  $P < .001$ ) were significant predictors of more favorable DCD attitudes, accounting for 29% of the variance in DCD attitudes overall.

### Common DCD Attitudes and DCD Knowledge Gaps

Total DCD Attitudes Scale scores ranged from 69 to 150 (mean = 122.5, SD = 16.4). The DCD attitudes were generally positive overall. Table 2 shows item mean scores (with reverse scoring, as indicated), SDs, and the percentage of critical care providers who agreed/strongly agreed and disagreed/strongly disagreed with each item. The majority felt that DCD allows something positive to come from the patient's death (89%, Family Comfort), comfortable giving full comfort measures to the patient in DCD cases (79%, Personal Comfort), a family's decision about DCD should be part of end-of-life care (77%, Process Satisfaction), and comfortable with the overall DCD process (53%, Personal Comfort). However, compared to brain death cases, some felt that DCD cases are more difficult

**Table 3.** Respondents' Knowledge of the Different Elements in the Study Institution's DCD Policy.<sup>a</sup>

DCD Knowledge Item (Correct Answer Per Policy)	% Correct
The determination of death can be made by the critical care physician, the transplant team, or the official representative of the organ procurement organization (F)	96
Death is declared after the irreversible cessation of circulation and respiration (T)	95
An official representative of the organ procurement organization is allowed to participate in the decision to withdraw life support (F)	91
Family members are allowed to be present at the time life support is withdrawn until death (T)	86
Brain death criteria must also be fulfilled before organ recovery begins (F)	83
After life support withdrawal, death must occur within 60 minutes, after which all organ recovery efforts must be stopped (F)	80
In some instances, organs can be recovered even if circulation does not irreversibly stop (F)	78
Life support can only be withdrawn in the operating room (F)	78
Five minutes of continuous pulselessness or asystole must occur before organ recovery can begin (T)	72
In some instances, postmortem procedures such as reintubation or chest tube insertion may be performed (T)	71
A patient must be on a ventilator to be considered for donation after circulatory death (T)	68
Consent of the patient or appropriate surrogate is required for any pre-mortem procedures and/or medications (T)	58
All costs from the time of donation consent/authorization until organ procurement is the responsibility of the organ procurement organization (T)	58
Only the kidneys and liver can be recovered and successfully transplanted (F)	51

Abbreviations: DCD, donation after circulatory death; F, false; T, true.  
<sup>a</sup>N = 112.

and less predictable (69%, Process Satisfaction), place more stress on staff (62%, Process Satisfaction) and families (32%, Family Comfort), less comfortable talking to families about DCD (48%, Personal Comfort), and less comfortable with DCD overall (31%, Personal Comfort) and with DCD death criteria, specifically (38%). The majority (93%, System Trust) felt that the OPO is trustworthy.

Table 3 shows the percentage of critical care providers who answered each knowledge item correctly, based on medical center policy. All items were answered correctly by a majority of survey respondents. Respondents were least likely to know that a patient must be on a ventilator to be considered for DCD (68%), all costs from the time donation is authorized until organ procurement is the responsibility of the OPO (58%), consent of the patient or appropriate surrogate is required for any pre-mortem procedures and/or medications (58%), and other organs in addition to kidneys and liver can be recovered and successfully transplanted following DCD (51%).

## Discussion

Controlled donation after circulatory determination of death has emerged as an important practice to expand the availability of transplantable organs,<sup>6,7</sup> although some studies have shown that health-care providers have less favorable attitudes about DCD compared to donation after brain death.<sup>14-19</sup> However, the lack of reliable and valid assessment tools has hampered subsequent research efforts seeking to systematically capture health-care providers' DCD attitudes, a gap we sought to fill in conducting this study. Using stakeholder engagement, we developed a comprehensive questionnaire to measure DCD attitudes, and our findings provide preliminary evidence of good internal consistency reliability, convergent validity, and construct validity. While qualitative assessment methods provide valuable information in the early stages of research, quantification of DCD attitudes has several notable advantages. For instance, it allows for more precise assessment of staff perceptions about DCD—both positive and negative—that can then be used to guide the development of educational strategies to improve overall acceptability and understanding of DCD. Additionally, self-administered questionnaires are more time efficient, convenient (ie, can be completed online), and amenable to repeated administrations to measure changes in attitudes over time, for example, to assess the effectiveness of quality improvement initiatives or educational programming.

Prior research identified common concerns that health-care providers have about DCD, including confusion about the determination of death, perceived ambiguity of circulatory death criteria (compared to brain death), the decision to withdraw life support, questions about the irreversibility of circulatory death, whether sufficient efforts are undertaken to preserve life, less comfort answering questions about DCD, and inconsistent implementation of DCD policies.<sup>17,23-26</sup> The exploratory factor analysis of the DCD Attitudes Scale supports these findings and further suggests a 4-factor structure of DCD attitudes, including those pertaining to the personal comfort of the critical care provider (factor 1), satisfaction with DCD processes (factor 2), the perceived comfort of the family (factor 3), and trust in the health-care and organ procurement systems pertaining to DCD (factor 4). Given the several overlapping items between our study and those developed by D'Alessandro et al,<sup>19</sup> it is not surprising that our factor structure provides additional empirical support for their antecedent model of DCD support, which emphasizes the role of psychological barriers, distrust, and concerns about the DCD process.

We found overall strong support and generally positive attitudes about DCD among critical care providers at 1 medical center. While a small minority felt that the time of continuous pulselessness or asystole before declaring death is too short or that cultural issues are not adequately considered in DCD cases, the majority felt that the medical center should participate in DCD, the regional OPO is trustworthy, DCD allows something positive to come from the patient's death, the DCD donor is heroic, and comfortable with the DCD process overall. The more favorable attitudes observed in our study compared

to others may be due to several factors. More direct experience with DCD predicted more positive attitudes and, considering the 40+-year experience with DCD in New England, which leads the country in both total number and percentage of organ donors that are DCD, it is possible that critical care staff in our study had more direct exposure to DCD than health-care providers in the other studies. Also, several years ago, the medical center implemented a multidisciplinary Organ Donation Council, chaired by the surgical director of the ICU, that engages in an ongoing performance improvement case review process of all deaths and provides targeted feedback to critical care providers designed to improve organ donation outcomes (eg, timely notification, family authorization rates, recovery of transplantable organs, etc). This type of formalized process has been shown to enhance organ donation metrics,<sup>27</sup> and it is possible that it contributed to more favorable DCD attitudes among health-care providers as well.

Critical care staff in this study also highlighted some issues that warrant closer examination. For instance, a strong majority of providers support discussion of the DCD option at the same time as the family's consideration of life support withdrawal. Some earlier research extolled the benefits of decoupling the explanation of brain death and the organ donation discussion,<sup>28,29</sup> which may explain why DCD protocols stipulate that families cannot be approached about organ donation until after the decision has been made to withdraw life support measures.<sup>4,5</sup> However, these initial findings about the importance of decoupling have not stood the test of empirical scrutiny and were developed in the context of family surrogates making both the withdrawal and the donation decision.<sup>30</sup> Nearly 50% of the organ donations in 2015 were authorized by the donor himself or herself through a donor registry prior to death. Accordingly, in cases where the potential DCD donor is a registered donor, the decision to donate has been very effectively decoupled from the decision to withdraw life support. For these reasons, the concept of decoupling needs to be reconsidered in the current DCD context. Critical care providers' support for discussing withdrawal of life support and organ donation simultaneously, which is likely based on their experiences in caring for these families, highlights the need for further discussion and scientific examination.

Knowledge of DCD policies and protocols at one's medical center or hospital seems essential for their consistent implementation. In the United States, the Joint Commission on Accreditation of Healthcare Organizations requires hospitals to develop written policies for organ and tissue procurement.<sup>31</sup> Although DCD policies have been widely developed, their specific elements vary considerably across medical centers and hospitals.<sup>20,21</sup> For instance, DCD policies differ in eligibility criteria, how circulatory death is defined and by whom it is declared, where life support can be withdrawn, the duration of asystole, and the time period in which asystole must be observed prior to declaration and for donation to proceed. Such variability has potential to compromise public trust and contribute to confusion and uncertainty among health-care providers, particularly those moving from one hospital setting to

another. It may also lead to lower conversion rates and transplantation yield. Moreover, it makes it difficult to develop a DCD knowledge questionnaire that can be applied broadly across medical settings with different policies. We developed knowledge questionnaire items that can be retained in their entirety, although the correct answers will differ based on local hospital policy.

Nearly half (43%) of study participants stated that they did not have a good understanding of the medical center's DCD policy, more so for those without much DCD experience. The low base rate of DCD cases in any given hospital (eg, the study institution typically has 8 to 10 potential DCD donors per year) makes it difficult to keep the knowledge of critical care providers current. There is ample evidence that memory for facts and information deteriorates and becomes less accessible as time elapses,<sup>32</sup> especially in the absence of meaningful cues. This may, in part, explain why only 18% of critical care providers correctly answered all 14 knowledge questions. As one strategy to improve the knowledge of critical care providers and maintain its accessibility over time, our regional OPO has appointed 2 associate medical directors with intensivist expertise in DCD who conduct seminars for health-care providers and help hospitals to develop new or clarify existing DCD policies. Medical centers and hospitals might also consider developing internal processes for ensuring that existing and new critical care providers have a good understanding of their DCD policy as well as a process for timely dissemination of any policy modifications. Brief online training programs, similar to modules commonly used in medical institutions (eg, infection control, workplace integrity, human patients protections, etc), may be an effective format for providing annual DCD policy education to designated health-care providers.

This study had several limitations. First, the survey was conducted at a large academic medical center in a major city with a long history of DCD activity and an active transplant center, thus limiting the generalizability of our findings. One-third of the deceased donors at our medical center are DCD (5/15 in the past 18 months) and our center performs about 100 transplants annually. Different findings might have emerged had this study been conducted at medical centers with different DCD policies, protocols, and experiences or without an active transplant program. Second, self-selection bias is inherent in any anonymous survey study. We achieved a high participation rate, yet it is possible that those who chose to complete the survey differed from nonresponders in ways that might have influenced study findings. Third, the reliability and validity of the DCD Attitudes Scale, although encouraging, must be viewed as preliminary due to our relatively small sample size. Further evaluation of this measure with a larger, more racially and geographically diverse sample of health-care providers is encouraged. Fourth, we examined attitudes about only 1 type of possible DCD, that is, patients for whom circulatory death is likely to occur after planned withdrawal of mechanical life support. Study findings, therefore, cannot be generalized to other classifications of potential DCD (eg, unsuccessful resuscitation or cardiac arrest in a brain dead donor).<sup>33</sup> Finally, we

focused this study on critical care providers, who may have more favorable organ donation attitudes than health-care providers in other settings.

## Conclusion

Health-care providers' DCD attitudes have important consequences for the appropriate identification of potential donors, timely referral to the local OPO, and willingness to discuss DCD with family members. We provide preliminary evidence for the utility, reliability, and validity of a questionnaire to measure DCD attitudes in critical care providers. Further research is needed to examine whether DCD attitudes can be improved and whether such improvement is associated with concomitant enhancement of the family's DCD experience and DCD authorization and conversion rate.

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